STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

INTERIOR BURBOT STUDY, PART A: TANANA RIVER BURBOT STUDY

by

Jerome E. Hallberg

ALASKA DEPARTMENT OF FISH AND GAME
Don W. Collinsworth, Commissioner

DIVISION OF SPORT FISH
E. Richard Logan, Director

TABLE OF CONTENTS

Study: N-8 NORTHERN PIKE/BURBOT Page

Job: N-8-1 Interior Burbot Study
Part A: Tanana River Burbot Study
by: Jerome E. Hallberg

LIST OF TABLES AND FIGURES

RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations of Alaska

Project: F-10-1

Study: N-8 Study Title: NORTHERN PIKE/BURBOT

Job: N-8-1 Job Title: Interior Burbot Study

Part A: Tanana River Burbot Study

Cooperators: Jerome E. Hallberg

Period Covered: 1 July 1985 to 30 June 1986

ABSTRACT

A comparison of 283 Tanana River burbot, *Lota lota* (Linnaeus), vertebrae and otoliths (used to determine age) showed no significant difference in the mean age between structures in the variability within or between readers for either one; thus, either structure can be used to determine the age of burbot from the Tanana River, and a variety of readers will generate comparable results.

In 1985, the male-to-female sex ratio of burbot sampled in the Tanana River was approximately 1:1; 77% of 203 burbot sampled were sexually mature at age 6, and all were mature at age 9. Data are presented describing the age, length, and weight frequency of burbot in the Tanana River.

Using hoop traps, a total of 653 trap nights was used to catch 998 burbot, resulting in an average catch per unit of effort of 1.5 fish per trap night. The burbot averaged 461 mm in total length; 841 of these burbot (300 mm and greater in length) were tagged.

Burbot appear to be distributed throughout the Tanana River and apparently occupy all types of habitat. Results from the 1983-1985 tagging studies suggest that burbot remain fairly resident within an area; if movement occurs, it is usually in an upstream direction.

KEY WORDS

Tanana River, burbot, hoop trap, vertebra, otolith, tagging study.

BACKGROUND

The Tanana River is a large, glacial stream that is formed by the confluence of the Chisana and Nabesna Rivers, near Northway, Alaska. It flows northwesterly for 440 mi and joins the Yukon River, approximately 4 mi east of the village of Tanana (Figure 1).

Because of the glacial nature of the river, sport fishing for most species is limited to those areas having clear-water tributaries nearby; e.g., the mouths of the Chena and Salcha Rivers. Burbot, *Lota lota* (Linnaeus), are found throughout the Tanana drainage and feed principally on other fish. As exemplified by their use of olfactory senses for feeding, burbot have adapted well to the silty waters of the Tanana.

Fishermen use trot-lines with up to 15 baited hooks to harvest burbot. Burbot fishing along the Tanana River, especially near Fairbanks, is one of the fastest-growing fisheries in the Interior. Harvest levels have more than doubled in recent years and have reached 2,000 burbot annually.

Research to assess the status of the burbot population in the Tanana River by the Alaska Department of Fish and Game (ADF&G) began in 1983. While the sample sizes were small, a data base, including age, length, weight, sex, and general distribution information, was established.

RECOMMENDATIONS

1. Tag burbot along the full extent of the Tanana River.

2. Fill the data gap for younger burbot (age 0 to 3) obtaining a large sample of vertebrae and otoliths.

3. Develop an index of abundance by conducting a mark-recapture population estimate in a section of the Tanana River and by indexing abundance in other river sections.

4. Explore the possibilities and techniques required to better estimate the recreational harvest (by anglers using set lines) of burbot in the Tanana River.

OBJECTIVES

1. To define the age, size and sex composition of the catch of burbot from the Tanana River and to compare burbot aging techniques utilizing the otolith and vertebra bones.

2. To conduct a burbot tagging program on the Tanana River, thus enhancing the existing data base concerning growth

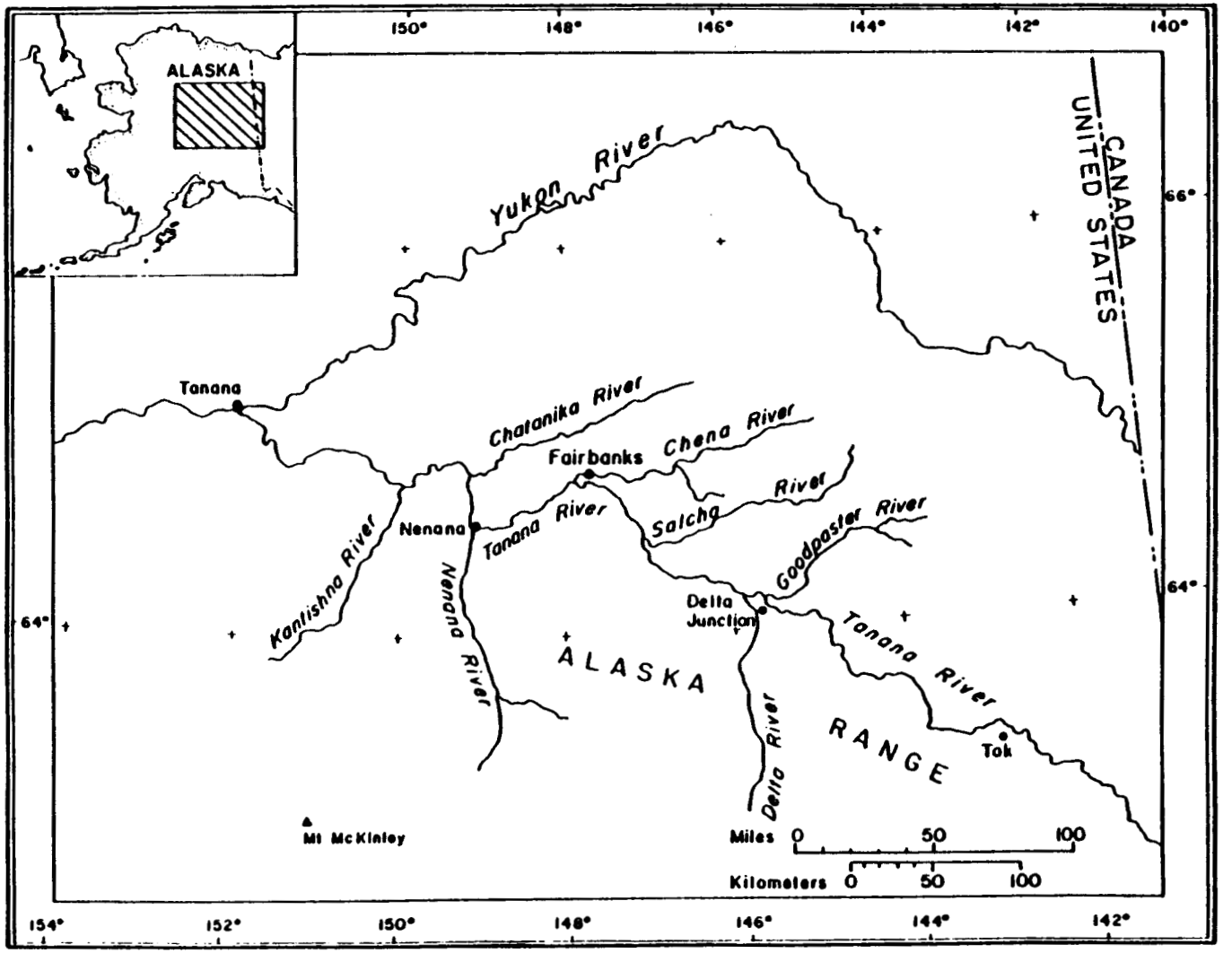

Figure 1. The Tanana River drainage.

rates and migratory behavior of Tanana burbot and providing information bracketing exploitation level of this population by recreational fishermen.

3. To develop an accurate and repeatable annual standard index of abundance statistic.

TECHNIQUES USED

In the Tanana River, a large outboard-powered riverboat was used to set hoop nets. Netting locations were selected according to fluctuating water levels and marked on 1:63,360 USGS maps.

Commercially available hoop nets (3 ft diameter by 12 ft long) were selected as the primary sampling tool for this study. Spreader bars made from 1-in (outside diameter) chlorinated polyvinyl chloride pipe were used to prevent the trap from collapsing. Traps were attached to the shore and allowed to fish with the opening facing downstream.

Frozen Pacific herring, *Clupea harengus pallasi* Valenciennes, were used as bait. Herring were put in perforated plastic containers and placed in the cod end of the hoop trap.

The otolith bone and a section of vertebrae containing at least two centrum bones were collected from a sample of burbot used for aging. Vertebrae were kept frozen until after the field season, at which time they were thawed, placed in a solution of common dish soap and water for approximately 24 hours, cleaned with a stiff-bristle tooth brush, and allowed to dry. The otolith bones were cleaned and then ground on a whetstone to aid in the age identification process.

FINDINGS

Aging Structure (Vertebra vs. Otolith) Analysis

Age and growth of fish can sometimes be determined through the length-frequency distribution or through tagging and recapture methods, but the most practical method is the study of annual marks laid down in skeletal structures of fish of known length. The skeletal structures commonly used for burbot age determination are the otolith and the vertebra centrum bone. Burbot scales are very small, deeply imbedded, and often without annuli and, thus, are not suitable for age determination.

During the 1985 field season, both vertebrae and otolith bones were collected from a total of 283 burbot. Each structure was examined three times each by four different fishery biologists to determine its age. Thus each structure was interpreted 12 times in total. The following are the findings from the analysis:

1. Within-reader variability ranged from 1.6 to 5.0 Average Percent Error (APE) for vertebrae and 2.9 to 5.7 APE for otoliths (Table 1).

Table 1. Estimates of within-reader variability based on Average Percent Error (APE)*.

Reader	Structure	Sample Size	APE
1	Vertebra	156	3.6
1	Otolith	156	3.2
2	Vertebra	156	5.0
2	Otolith	156	5.7
3	Vertebra	156	1.6
3	Otolith	156	2.9
4	Vertebra	156	3.4
4	Otolith	156	3.5

* Formula for Average Percent Error (APE) from Beamish and Fournier (1981) modified so that X_j = the average age calculated from the jth, rounded to the nearest 1 year.

$$\frac{1}{R} \sum_{R} \frac{Xij - Xjl}{X_j} \times 100$$

2. Between-reader variability was 6.9 APE for vertebrae and 7.3 APE for otoliths.

3. For all readers, there were no significant differences in the mean age of samples (analyzed separately) read with vertebrae versus those of the same samples read with otoliths (Table 2, Figure 2).

4. For the samples read, there was a slight tendency to age otoliths one year older than vertebrae, although the difference was not significant for all readers (Figure 3).

Based on these findings, it appears that there is no difference in variability within or between readers for either of the aging structures. Therefore, using a variety of readers to determine the age of Tanana River burbot, either structure could be used to provide comparable results.

The slight tendency to age otoliths one year older than vertebrae is probably due to the readers' inexperience in examining vertebra structures and the difficulty in identifying the first vertebra annulus.

Length, Weight, and Sex of Burbot Sampled for Aging

Of the 283 burbot used in the aging study, 168 were selected from hoop-trap catches obtained during the tagging study, and 115 were turned in by anglers. The meat had been filleted off the angler-supplied fish, but the head was connected to the skeletal system; thus, I was able to obtain vertebrae and otoliths as well as a total-length measurement. However, weight, sex, and maturity data were not available on some of the samples received from anglers.

The sex ratio of 203 burbot within the sample was approximately 1:1, with 99 males and 104 females; 77% of these fish (both males and females) were sexually mature by age 6, and all were mature by age 9.

Of 283 burbot aged, age ranged from 0 to 20 years (Table 3), and length ranged from 133 to 1,135 mm (Fig. 4). Burbot ranging from age 3 to age 10 accounted for approximately 85% of both samples. The mean length for the entire sample was 551 mm and the mean weight was 1,306 g; the average age of the burbot in the sample was approximately age 8.

Weights of individual burbot vary greatly. Fish of similar lengths and age often differed in total weight by as much as 1,000 g (2.2 lbs). Chen (1969) stated that a gorged burbot stomach and the intestine could make up as much as 25% of the body weight. This is reflected in the weight-range of burbot in the sample (Table 4); fish of the same age and length differed considerably in weight.

Burbot Tagging Project

The burbot-tagging project in 1985 was conducted in seven different sections of the Tanana River (Table 5). In sections 1 through 4, the project was conducted by the Fairbanks staff, while sections 5, 6 and 7 were completed by the Delta Junction staff. Baited hoop traps were used

Table 2. Summary statistics for vertebra age vs. otolith age by reader.

Reader	Mean	95% C.I.	Probability
1	-0.28	-0.72 to 0.16	0.21
2	-0.38	-0.86 to 0.10	0.12
3	-0.16	-0.57 to 0.27	0.48
4	-0.14	-0.55 to 0.26	0.48

* Probability levels were determined from a paired t-test. The hypothesis tested was: The difference between vertebra age and otolith age is 0 years.

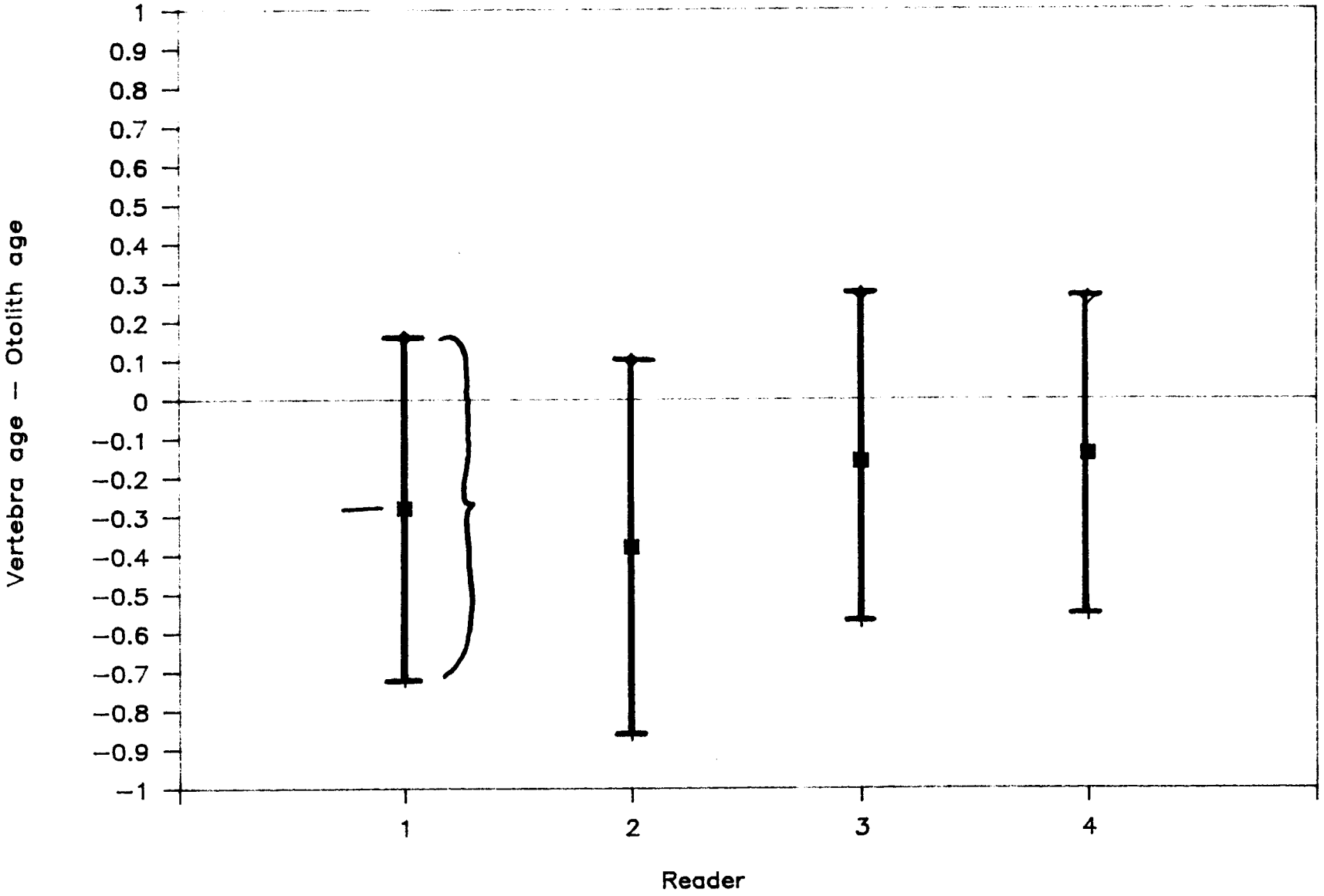

Figure 2. Mean difference and 95% C.I. between vertebra age and otolith age.

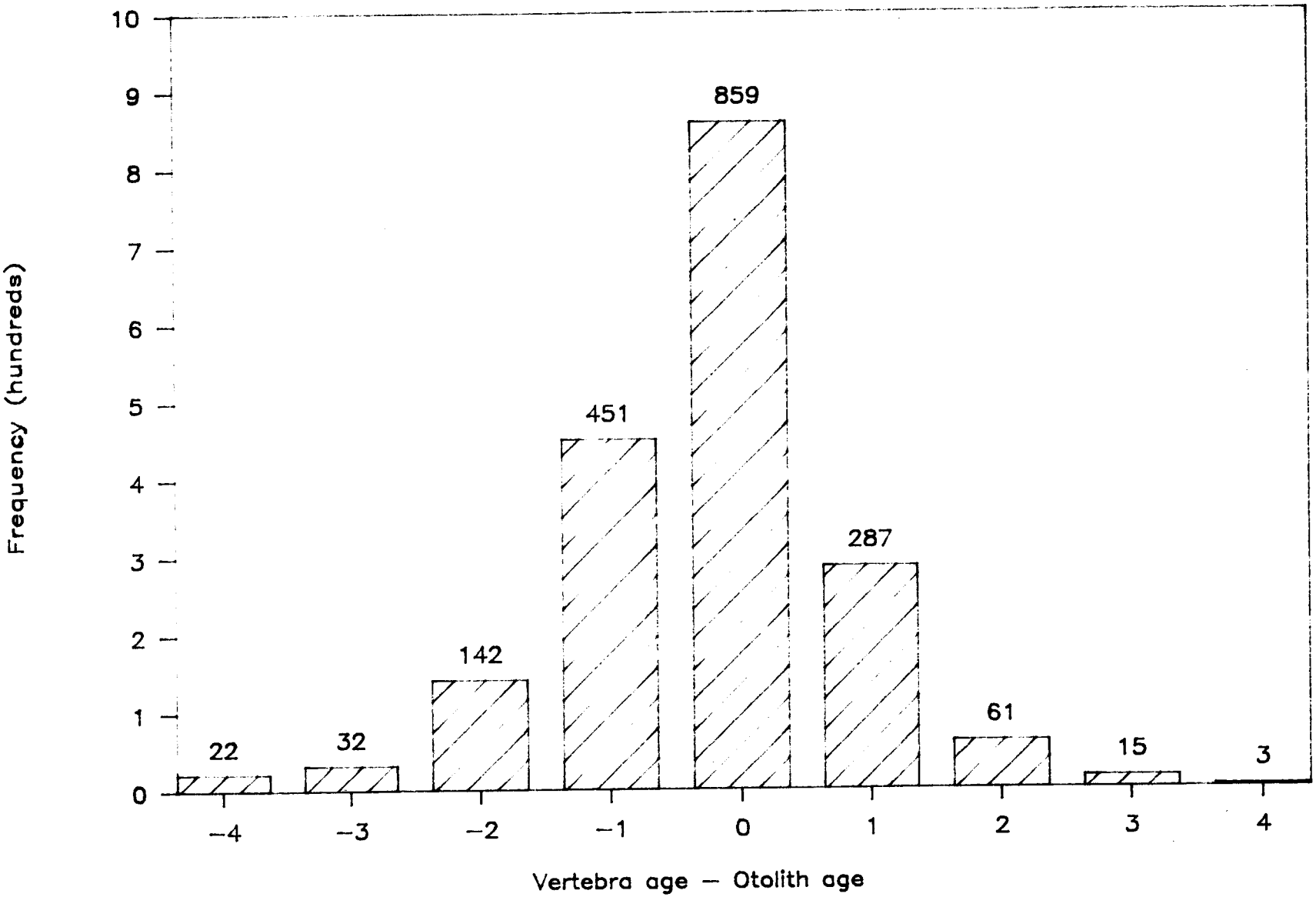

Figure 3. Combined frequency of differences between vertebra age and otolith age for four readers.

Table 3. Age-length frequency of 283 burbot from the Tanana River, 1985.

Age	Weight (g) Mean	Weight (g) Range	Number	Percent	Standard Error (mm)
0	141	133- 152	4	1.5	4
1	172	162- 184	10	3.0	2
2	300	300	1	0.5	0
3	299	220- 470	14	5.0	15
4	384	290- 489	23	8.0	10
5	435	376- 542	21	7.0	10
6	501	405- 603	42	15.0	8
7	517	426- 634	33	12.0	8
8	564	436- 711	28	10.0	11
9	616	450- 749	35	12.0	9
10	681	510- 915	23	8.0	16
11	731	629- 815	15	5.0	17
12	775	715- 810	7	2.5	11
13	768	620- 882	8	3.0	32
14	880	785-1035	7	2.5	34
15	869	825- 950	3	1.0	33
16	920	822-1020	4	1.5	35
17	933	915- 950	2	1.0	12
18	...	...	...	...	...
19	1099	1080-1117	2	1.0	13
20	1135	1135	1	0.5	...

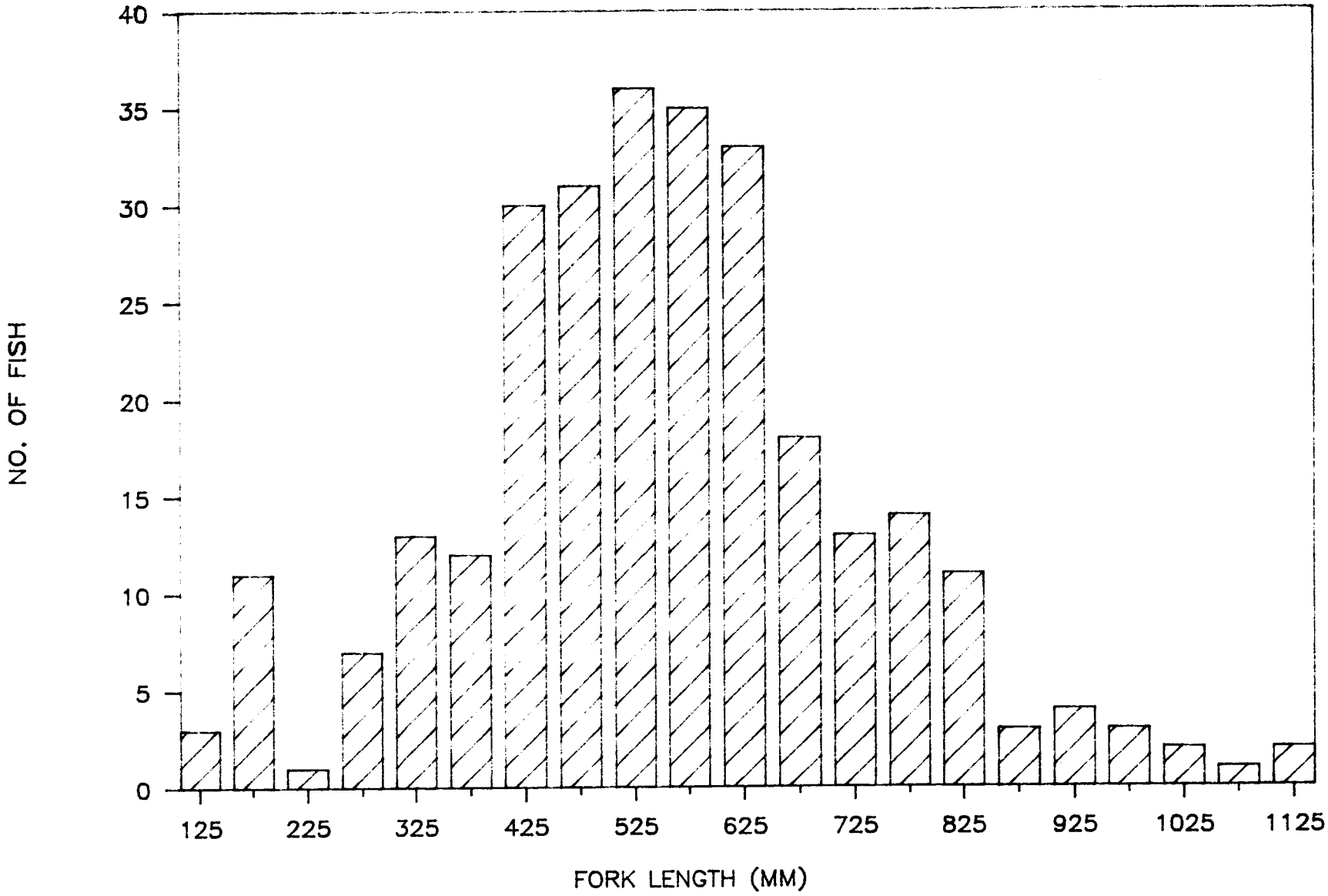

Figure 4. Length frequency of 283 burbot sampled for aging analysis; 115 were obtained from anglers and, 168 selected from hoop trap catches on the Tanana River, 1985.

Table 4. Age-weight frequency of 215 burbot from the Tanana River, 1985.

Age	Weight (g) Mean	Weight (g) Range	Number	Percent	Standard Error (g)
0	158	133- 183	2	1.0	18
1	328	273- 390	3	1.5	28
2	220	220	1	0.5	0
3	311	150- 801	13	6.0	65
4	334	170- 610	23	11.0	25
5	510	270-1270	20	9.0	47
6	724	365-1070	39	18.0	33
7	855	490-1650	26	12.0	53
8	1038	460-2180	23	11.0	72
9	1428	440-2220	20	9.0	82
10	2183	620-5950	14	6.0	325
11	2523	860-3600	10	5.0	212
12	2613	2450-2740	3	1.5	70
13	2978	1750-4400	3	1.5	630
14	5073	3150-6065	5	2.0	513
15	3750	3750	1	0.5	0
16	5148	3600-7000	4	2.0	684
17	4055	3910-4200	2	1.0	103
18	0	0	0		
19	8204	7450-8958	2	1.0	533
20	7825	7825	1	0.5	

Table 5. Summary of burbot catch, effort, CPUE, number of burbot tagged, and mean length for seven sections of the Tanana River, 1985.

Section	Dates	Location	Total* Effort (NN)	Total Catch	CPUE	Total Tagged	$\bar{x}$ Length (mm)
1	1-4 October	Mouth of Wood River to mouth of Chena River	84	199	2.4	123	488
2	12-16 August	Mouth of Chena River to mouth of Moose Creek	96	109	1.1	100	511
3	29 July - 2 August	Mouth of Moose Creek to mouth of Salcha River	87	72	0.8	60	544
4	24-28 June	Mouth of Salcha River to mouth of L. Delta Creek	93	97	1.0	78	452
5	10-14 June and 16-17 September	L. Delta Cr. to Tanana bridge at Big Delta	104	145	1.4	116	437
6	8-12 July, 5-9 August and 19-20 September	Tanana bridge to mouth of Volkmar River	170	312	1.8	304	414
7	5-9 August	Volkmar River to Northway	19	64	3.3	60	463
Totals			653	998	1.5	841	461

* Effort is expressed in net nights, 1 NN = approximately 24 hours.

to capture burbot. These traps were tied to shore and fished with the entrance of the trap pointing downstream. The Tanana River is a meandering glacial stream, having many side channels and backwater slough areas. Water depth and velocity can vary greatly within the river. During our hoop-trapping and tagging project, as many different types of habitat as possible were sampled so that the areas preferred by burbot could be identified. However, burbot seemed to be distributed throughout the system, and we did not identify any one habitat type that significantly outproduced the others.

During the 1985 field season, 998 burbot were caught in the Tanana River (from the Wood River upstream to approximately the mouth of the Healy River). Of these, 841 burbot greater than 300 mm long were tagged and released. This amount brings the total number of tagged burbot in the Tanana River since 1983 to 1,040; in 1983 100 were tagged, and in 1984 an additional 99 were tagged (Hallberg 1985). Total tag recoveries from anglers and the staff for each of the 3 years were 13, 5, and 15, respectively. Only eight tags were returned by anglers; all of them were from 1985.

Recoveries of 24 tagged burbot indicated no significant movements, in that the fish were caught within 5 mi of where they were tagged. The remaining nine fish showed considerable movement, all in an upstream direction, averaging 40 mi. One individual tagged near Rosie Creek was caught 7 months later near the mouth of Shaw Creek, which is 113 mi upstream.

The mean total length of burbot was 461 mm, and the lengths did not vary significantly from one section of the Tanana River to another. Mean age was approximately 5 to 6 years. Mean total length of burbot sampled for the aging analysis (n=283) was 551 mm. The larger size of the fish in the aging sample reflects the anglers' preference for keeping larger fish (40% of the burbot used for the aging analysis were obtained from anglers). Burbot ranging from 325 to 575 mm and from 3 to 9 years comprised 84% of the total sample (Fig. 5).

The hoop-trap catches for each section of the river ranged from 0.8 to 3.3 burbot per net night (Table 5). These figures reflect only the catch, and while they can likely be used for comparative purposes in future sampling in the same areas, they may or may not provide an adequate index of abundance. A mark-recapture population estimate for a 5-mi section of the Tanana River is planned to be conducted in 1986. If successful, this may provide an additional abundance estimator that can be used on an annual basis to determine how the population is responding to the current level of harvest. Additional information concerning Tanana River burbot catch per unit of effort may be found in part C of the overall investigation.

LITERATURE CITED

Beamish R.J. and D.A. Fournier. 1981. A method for comparing the precision of a set of age determinations. Canada J. Fish. Aquat. Sci. 38:982-983.

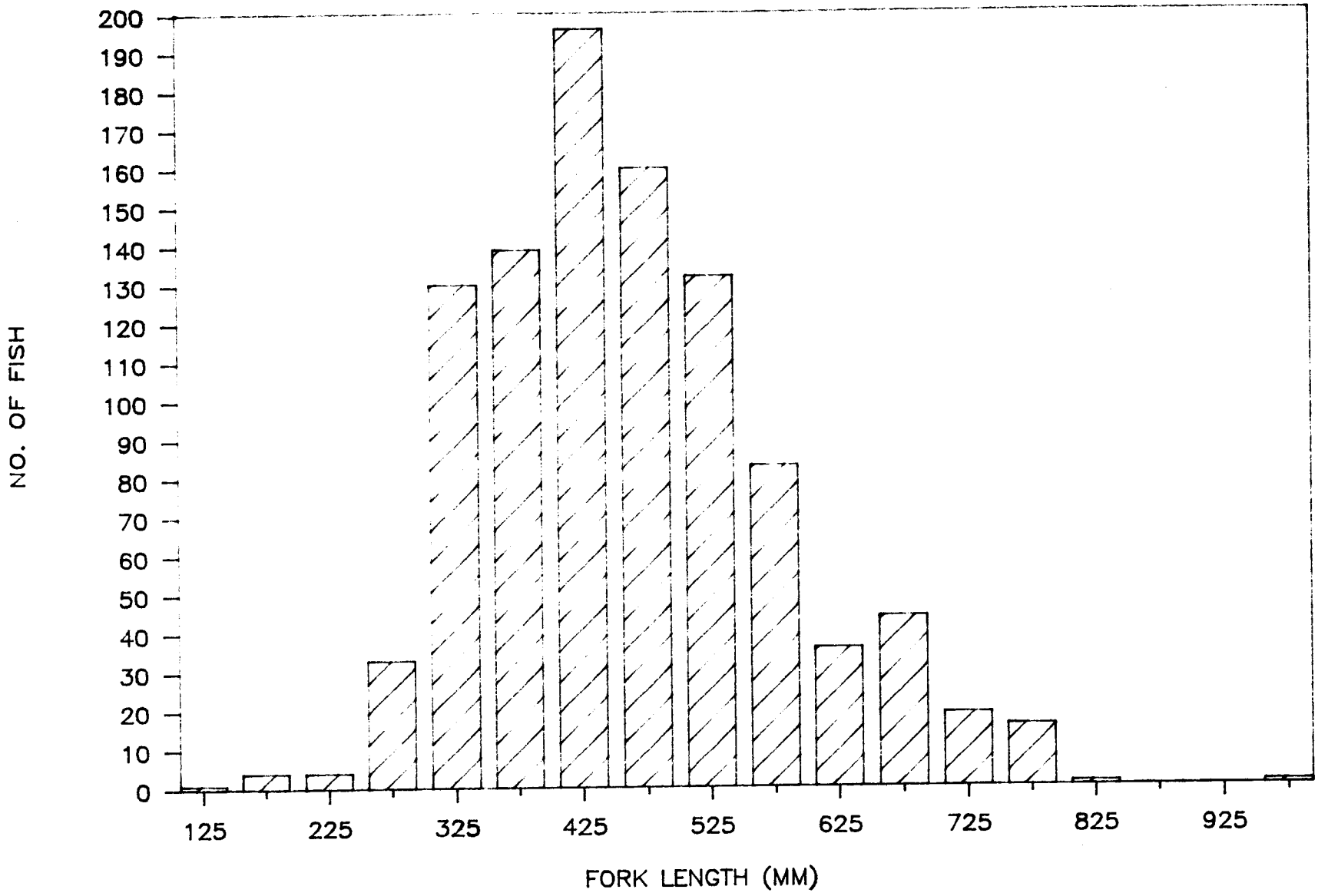

Figure 5. Length frequency distribution for 998 burbot captured with hoop trap, Tanana River, 1985.

Chen, Lo-Chai. 1969. The Biology and Taxonomy of the Burbot, *Lota lota* Leptura, in Interior Alaska. Biological papers of the University of Alaska, Number 11.

Hallberg, J.E. 1985. Evaluation of interior Alaska waters and sport fish with emphasis on managed waters, Fairbanks District. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1984-1985, Project F-9-17, 26(G-III).

Prepared by:

Jerome E. Hallberg
Fishery Biologist

Approved by:

E. Richard Logan, Ph.D. Director
Division of Sport Fish

Louis S. Bandirola, Deputy Director
Division of Sport Fish